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Comparative Efficacy and Economic Appraisal of Different Feeds in Sexed Broilers

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The current study was conducted to check the influence of different dietary treatments on growth performance and immunological feedback in sexed broilers. A total of 600 day-old chicks, obtained from a private hatchery, were assigned to 12 treatments (randomly) in a 3 (sex rearing) × 4 (feeding regimes) factorial setting under a CRD. The treatments comprised three sex-rearing techniques (i.e., male, female, and straight run) and four feeding protocols (standard, higher-density, NRC, and soya-corn). Each dietary treatment was replicated five times, with ten birds per replica. Parameters including feed intake (FI), live body weight, weight gain, feed conversion ratio (FCR), and Newcastle disease (ND) titer were evaluated. The collected data was tested while using the ANOVA inside factorial setups. The results showed an enhanced feed conversion ratio in males and straight-run individuals compared to females. The higher-density diet demonstrated increased body weight, improved FCR, and enhanced antibody titer against ND. The introduction of a high-density feed and the individual raising of males yielded optimal profit. Providing a higher density diet may lead to improved performance of broilers, resulting in enhanced profitability.

Keywords: Production performance, feed, sex, economic, efficacy, digestibility, broiler.

INTRODUCTION

The primary objectives of the broiler industry are to formulate diets that optimize growth performance and enhance economic returns (Gheisari *et al.,* 2015). The use of a quality diet is essential for enhancing the performance of birds and optimizing feed efficiency (Al Neemi *et al.,* 2016). In addition, for improved health and performance, the diet of the animal must include sufficient amounts of all necessary nutrients, including amino acids (Cengiz *et al.,* 2008). The deficiency of the amino acid may hinder animal growth and decrease feed efficiency. A significant amino acid imbalance primarily impacts the consumption of feed, subsequently influencing growth rate. Excessive amino acid levels can lead to compromised growth performance (Cengiz *et al.,* 2008).

Globally, certain broiler industries often decrease nutrient density to lower overall expenditures on feed, as feed constitutes the majority of poultry production expenses. Other companies similarly cut dietary protein to enhance live production revenues. There is, however, conflict regarding the impact of reduced nutrient density or amino acids on production performance and revenue (Corzo *et al.,* 2005). Additionally, there are numerous controversies in the literature regarding the optimal protein levels in broiler diets necessary for achieving satisfactory performance. Previous investigations indicated that a decrease in dietary protein resulted in lower live weight gain, higher intake of feed, and an improved conversion efficiency of the feed (Gheisari *et al.,* 2015). Consequently, concerns arise regarding the potential negative impact of diminished dietary protein on birds growth, even with the incorporation of essential amino acids. Furthermore, chickens provided with low-protein diets, despite receiving adequate amounts of each key amino acid necessary for optimal growth, frequently did not improve. Consequently, it was shown that chickens need essential amino acids (EAA) along with a supplemental quantity of non-essential amino acids (NEAA) for making protein at satisfactory rates. Thus, it is evident that hens need not only the EAA but also additional amounts of NEAA. It is apparent that a certain amount of these NEAA is important for growth.

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A combination of EAA and NEAA is also known as the CP needed (NRC, 1994). Although the necessity for the amino acid (AA) composition is more comprehensively recognized, it is imperative to find and further examine dietary variables that could optimize live performance. This study aimed at assessing the impact of various feeding regimens, determined by nutrient density, on the growth performance of sexed commercial broilers.

MATERIALS AND METHODS

The experimental protocols followed the guides and practice codes established by the University of Veterinary and Animal Sciences (UVAS), Lahore. Ethical permission was obtained prior to the commencement of the experiment.

***Experimental birds, housing and feeding*:** The research was carried out at the Poultry Research and Training Centre, Ravi Campus, UVAS, Lahore, for a period of 35 days. A total of 600 day-old sexed broilers were obtained from a corporate hatchery. The experimental birds were allocated to 12 treatments (randomly) in a 3 (Sex rearing) × 4 (Feeding regimes) factorial design, replicated 5 times with 10 birds per replicate, following a CRD. Group A birds were provided with an NRC diet, whereas groups B, C, and D received HD, corn-soy base, and conventional diets, respectively. Simultaneously experimental birds in a commercial hatchery were feather sexed and vaccinated against ND and IB through a spray cabinet. Moreover, a complete dose of the Marek's vaccine was subcutaneously administered at hatch. Males, females, and birds in a straight run were individually housed in floor pens (36) with a density of 10 birds per pen. Each floor pen had an area of 16 square feet and included one pan feeder, five nipple drinkers, and a built-up rice husk. Feeding trays with crumbled feed (1 lb) were positioned in the pens on day 0 and eliminated, followed by the feed consumption. Birds were offered with feed and water freely. Experimental birds were provided with light cycles with respect to light hours (23 hrs.) and dark hours (1 hr.) during the rearing period. The house featured environmental control systems that enabled the modulation of light intensity in accordance with present industry standards. Composite specimens of the experimental feeds were collected and tested for the proportions of amino acids/protein (Tables 1 to 4). Broilers were fed experimental diets (crumbles) from 1 to 35 days of age, divided into three phases: 1 to 14 days, 15 to 21 days, and 22 to 35 days (Tables 1 to 4). The dietary treatments varied in the concentration of dietary amino acids.

***Measurements and blood sampling*:** Pen weights and the intake of feed were monitored on a weekly basis. Mortalities were recorded bi-daily and measured for their weight. Feed conversion was adjusted in every phase by omitting the weight of mortality. During the end of the experimentation, three birds were selected at random for every replicate, and blood sampling was done while collecting blood from the jugular vein using a 5 ml disposable syringe without anticoagulant. Following centrifugation of blood at 3000×g for 10 minutes, the extracted serum was kept at -20°C and promptly dispatched for assessment of blood hematology, specifically glucose and cholesterol (Gunes *et al.,* 2002). These parameters were assessed using a specialized spectrophotometer (Systronics). Vaccination of the experimental birds was done against ND intra-ocularly one week earlier than sampling. The antibody reaction to the NDV was examined using the HI (Beard, 1989) and following the methodology (Xie *et al.,* 2008). The concentration for the NDV was presented as log2 of the reciprocal of the final serum dilution, demonstrating HI. The antigen for the HI-test against the ND virus was obtained from the UVAS, Lahore.

***Statistical Analysis*:** Prior to analysis, the data were assessed for uniformity and homogeneity of variance. Upon confirming normality, the data were analyzed using the ANOVA within a factorial design, employing the GLM- SAS. Sex-specific background and feeding regimes were considered as primary factors. The relationship between distinct sex-rearing and feeding regimes was also examined. The treatment means were compared and interpreted while using Duncan's Multiple Range test at a 5% significance level.

RESULTS AND DISCUSSION

***Feed intake*:** Different sex rearing (P=0.2417) and feeding regimes (P=0.34105) separately could not show any effect on feed intake (FI) except their interaction which showed significant difference (P=0.0110; Table. 5). Similarly, (Roy *et al.,* 2010) also observed almost similar FI despite variation in protein contents, showing no influence of different protein levels on feed intake. In contrast to our observations, (Bregendahl *et al.,* 2002)observed increased FI due to LD diets, indicating that there is negative correlation between FI and CP in diets. It was claimed that decreasing CP content from high to low resulted in enhanced FI. Kamran *et al.* (2008) reported increased FI due to decreasing protein content. Interaction of feeding regimes and different sex rearing indicated significant differences in FI.

***Body weight*:** All treatments including separate or combined sex rearing, feeding regimes showed variations in body weight (BW), whereas their interactions could not show difference (P=0.3517; Table. 5). Males separately and mixed sex (males + females) rearing demonstrated higher BW than females. The genetic composition of males may account for their greater body weight, as studies indicate that males exhibit higher efficiency and growth rates compared to females. Fayeye *et al.* (2006) similarly identified the difference in gain to the genetic implications of sex resulting from male physiology. Sex differences have been reported to typically arise from variations in hormonal profiles (Ilori *et al.,* 2010). A comparative study aimed at examining the

performance of different sexes also revealed higher live weight gains in males compared to females (Corzo *et al.,* 2005).

Table 1. Nutrient composition of NRC diet.

Items	Phases		
	0-14 days (Starter)	15-21days (Grower)	22-35days (Finisher)
Kcal AMEn/kg diet	3200	3200	3200
CP %	23	20	18
Arginine	1.25	1.10	1
Glycine+Serine	1.25	1.14	0.97
Histidine	0.35	03.2	0.27
Isoleucine	0.8	0.73	0.62
Leucine	1.20	1.09	0.93
Lysine	1.10	1.00	0.85
Methionine	0.50	0.38	0.32
Methionine+cysteine	0.90	0.72	0.60
Phenyalanine+tyrosine	1.34	1.22	1.04
Proloine	0.60	0.55	0.46
Threonine	0.80	0.74	0.68
Tryptophan	0.20	0.18	0.16
Valine	0.90	0.82	0.70

Table 2. Nutrient composition of High density (HD) diet.

Items	Phases		
	0-14 days (Starter)	15-21days (Grower)	22-35days (Finisher)
CP%	23	22	21
ME	3000	3100	3200
Dig. Lysine	1.21	1.21	1.01
Dig.Methionine	0.54	0.50	0.45
Dig. M+C	0.88	0.81	0.76
Arginine	1.25	1.16	1.07
Threonine	0.80	0.74	0.68
Tryptophan	0.19	0.18	0.16
Calcium	0.90	0.85	0.80
Available phosphorus	0.50	0.48	0.46
Sodium	0.16	0.16	0.16
Potassium	0.55	0.55	0.55
Chloride	0.30	0.30	0.30

Adequate supply of nutrient to modern commercial broilers has long been an interest of nutritionists (Olayode *et al.,* 2014). Birds should receive all essential nutrients in sufficient quantities, with modest surpluses as well included (Roy *et al.,* 2010). Moreover, the birds fed highly densed diet (HD) demonstrated remarkably higher live weight gains compared to those fed conventional feed (Table. 5). High density diet contains adequate amount of protein and EAA, which might have contributed in muscles development of the birds, leading to more BW. Increased BW, similarly, was observed in birds receiving HD diet (Dozier *et al.,* 2006), indicating that body weight increases with high protein contents (Bouvarel *et al.,* 2004) or high density diets (Corzo *et al.,* 2005). However, low protein or low density (LD) diets offered to the broilers and observed reduced BW, concluding that LD diet has adverse effects on BW (Gheisari *et al.,* 2015).

Table 3. Nutrient composition of Soya corn based diet.

Items	Phases		
	0-14days (Starter)	15-21days (Grower)	22-35days (Finisher)
CP%	21	20	19
ME(Kcal/kg)	3000	3100	3200
Corn	51	59.18	60.10
Soya bean meal	26	21.70	17.50
Wheat	2.50	-	-
Wheat bran	1	-	-
Sunflower meal	6	7	10
Corn gluten meal	5	5	5
Sunflower oil	2.90	3.10	4.10
Limestone	1.48	1.57	1.57
Dica.Phosphate	1.55	1.40	0.92
Sodium chloride	0.38	0.39	0.22
Vit and min	0.50	0.50	0.50
HCl lysine	0.08	0.14	0.09
Dl Methionine	0.13	0.02	-

Table 4. Nutrient composition of Conventional diet.

Items	Phases		
	0-14 days (Starter)	15-21 days (Grower)	22-35 days (Finisher)
CP %	20	19	18
ME Kcal/kg	3100	2900	2800
Maize	54.85	46.53	58.70
Rice polish	5.00	7.00	6.00
Wheat bran	3.00	3.50	4.00
Canola meal	6.05	11.00	1.67
Rapeseed meal	4.00	3.00	4.00
Soybean meal	16.00	17.00	17.50
Corn Gluten meal	1.60	1.27	1.60
Poultry byproduct	2.00	1.00	1.00
Fish meal	2.50	3.00	0.00
Marble chips	0.55	0.30	0.73
DCP	0.53	0.80	1.12
Lysine sulphate	0.48	0.50	0.53
DL Methionine	0.18	0.10	0.19
Threonine	0.05	0.02	0.08
Molasses	2.50	3.50	2.25
Premix	0.43	0.30	0.26
Salt	0.23	0.25	0.32
Phyzyme	0.05	0.05	0.05
Rice Broken	0.00	0.00	0.00
Total	100.00	100.00	100.00

***Feed conversion ratio (FCR)*:** All treatments including their interaction showed pronounced effects on FCR (Table. 5).

Males and straight run indicated better FCR than females (Table 5). Improved FCR in males and straight run may be attributed to the higher growth potential of males as it is reported that males grow faster than females and convert consumed feed into live body weight more efficiently (Corzo *et al.*, 2005). Substantiating the current findings, a previous study also claimed better FCR in male broilers than females (Novel *et al.*, 2009).

Table 5. Effect of different feeding regimes on feed intake (FI), body weight (BW), feed conversion ration (FCR) and mortality (M) in sexed commercial broilers.

Effects	Observations			
	FI (gm)	BW (gm)	FCR	M (%)
Sexes				
Male	3614.1 ±65.4	2109.9 ±23.8^{a}	1.7 ±0.03^{b}	5.0 ±1.5
Female	3547.2 ±41.5	1962.2 ±34.3^{b}	1.8 ±0.02^{a}	4.2 ±1.5
Straight run	3493.5 ±69.2	2082.6 ±37.9^{a}	1.6 ±0.03^{b}	5.0 ±1.5
Feeding regimes				
Conventional	3606.3 ±59.8	1995.4 ±26.6^{b}	1.8 ±0.02^{a}	4.4 ±1.7
High density	3512.1 ±53.6	2112.4 ±38.0^{a}	1.6 ±0.03^{b}	3.3 ±1.6
NRC	3601.8 ±100.4	2075.4 ±47.5^{ab}	1.7 ±0.04^{ab}	5.5 ±1.7
Soya corn	3486.2 ±55.0	2023.2 ±49.4^{ab}	1.7 ±0.04^{ab}	5.5 ±1.7
P value				
Sexes	0.2417	0.0050	0.0010	0.9203
Feeding regimes	0.3410	0.0125	0.0062	0.8211
Sexes × Feeding regimes	0.0110	0.3517	0.0024	0.9297

$^{a-b}$Means within column with different superscripts differ (P <0.05); Data are means ± SE of 5 replicates (n = 5)

It was evidenced that the birds receiving an HD diet demonstrated better FCR, followed by those fed soya corn, NRC, and conventional feed. Improved FCR in HD diet fed group may be due to the enhanced BW of birds in that group. In literature, the HD diet is described as having beneficial effects on growth performance, including FCR (Sterling *et al.*, 2003). When broilers are fed high dietary protein, they utilize feed more efficiently, ameliorating FCR. Similar to the current findings, certain other studies also claimed ameliorated FCR as a result of HD diet (Pesti *et al.*, 2009), indicating that higher protein content in diets can improve FCR (Roy *et al.*, 2010). Kamran *et al.* (2008) found poor FCR in birds raised on LD diet, concerning that LD diet can adversely affect the final FCR (Gheisari *et al.*, 2015).

***Glucose and cholesterol level*:** No variations were found in glucose level with respect to different feeding regimes (P=0.6096) and sex (P=0.2225), including their interaction (P=.0.1534; Table 6). Similarly, it was reported that carbohydrate metabolism is not dependent on sex as well as on diet. Glucose level, likewise, was observed to be unchanged in different sexes and feeding regimes. Similar to the glucose, cholesterol level was also found to be not affected by different feeding regimes (P=0.9835), sexes (P=0.6093) and their association (P=0.4470; Table. 6). The relative constant level of plasma cholesterol as seen in the chicks fed different feeding regimes could be attributed to the hereditary factors, since the chicks came from the same stock, probably; there are not much variations in their endogenous biosynthesis of cholesterol. Similar to our observations, Mostafa *et al.* (2012) did not observe any sex-related impact on the blood cholesterol concentrations.

Table 6. Effect of different feeding regimes on glucose (Glu), cholesterol (Chol) and Newcastle disease (ND) titer in sexed commercial broilers.

Effects	Observations		
	Glu (mg/dL)	Chol (mg/dL)	ND titer (log_2)
Sexes			
Male	156.6±5.1	206.2±5.9	4.2±0.3
Female	156.2±3.3	202.0±7.4	4.4±0.3
Straight run	166.4±5.6	211.5±5.7	4.6±0.2
Feeding regimes			
Conventional	165.2±5.8	207.4±5.0	4.4±0.2^{b}
High density	160.6±7.5	205.2±9.4	5.5±0.1^{a}
NRC	156.6±5.2	204.9±8.6	4.5±0.2^{b}
Soya corn	156.4±3.6	208.6±6.5	3.1±0.2^{c}
P value			
Sexes	0.2225	0.6093	0.1573
Feeding regimes	0.6096	0.9835	<0.0001
Sexes ×Feeding regimes	0.1534	0.4470	0.1109

$^{a-c}$Means within column with different superscripts differ (P <0.05); Data are means ± SE of 5 replicates (n = 5)

***Antibody titer and mortality*:** Antibody titer against ND was observed to be affected only by feeding regimes, whereas sex (P=0.1573) alone and in interaction (P=0.1109) with feeding regimes could not show effect on antibody titer (Table. 6). High-density diet indicated higher antibody titer against ND, indicating that antibody titer varies with difference in composition of the diets. Corroborating the current finding, it was reported that humoral immune response is reduced with decreasing protein contents in the diet (Abbasi *et al.*, 2012). Similarly, a recently conducted study on broilers also indicated a significant (P<0.05) influence of dietary interventions interlined with the immune response against the ND. Mortality was found to be not affected in all treatments

including feed types (P=0.8211), sex (P=0.9203) and their association (P= 0.9297; Table. 5). Similarly, Corzo *et al.* (2005) observed no any effect of sex or feed type on mortality percentage. In another study, control and high Lys doses likewise showed similar patterns in mortality.

***Profitability*:** Separate rearing of male broilers and using HD diet both remained economical. According to our findings, the greater profitability was found in male with straight run followed by the females (Table. 8). Among different feeding regimes, HD diet have the better average profit followed by NRC, Soya corn based diet and conventional feed (Table. 7).

Table 7. Economics with respect to feeding regimes.

Items	Feeding Regimes			
	HD	N	C	S
Cost of day old broiler chick	30.00	30.00	30.00	30.00
Avg. feed consumed (Kg)	3.50	3.60	3.63	3.48
Feed cost starter	26.25	26.25	24.15	24.15
Feed cost grower	25.20	24.15	22.57	24.15
Feed cost finisher	112.79	110.51	111.19	108.49
Total feed cost (PKR)	164.24	160.91	157.91	152.79
Miscellaneous cost / bird (PKR)	30.00	30.00	30.00	30.00
Total cost / bird (PKR)	224.24	220.91	217.91	216.79
Total live weight / bird (PKR)	2.13	2.07	1.99	2.03
Market price/ Kg live wt. (PKR)	118.00	118.00	118.00	118.00
Avg. cost / Kg live weight (PKR)	105.27	106.71	109.50	106.79
Avg. profit/ Kg live weight (PKR)	12.72	11.29	8.49	11.20

HD = high density N = NRC C = conventional S = soya corn

Table 8. Economics with respect to different sex rearing.

Items	Sexes		
	M	F	SR
Cost of day old broiler chick	30.00	30.00	30.00
Avg. feed consumed (Kg)	3.61	3.50	3.55
Avg. feed price /Kg (PKR)	46.00	46.00	46.00
Total feed cost (PKR)	167.26	162.15	164.47
Miscellaneous cost /bird (PKR)	30.00	30.00	30.00
Total cost /bird (PKR)	227.26	222.15	224.47
Total live weight /bird (PKR)	2.13	1.96	2.08
Market price/ Kg live wt. (PKR)	118.00	118.00	118.00
Avg. cost /Kg live weight (PKR)	106.69	113.34	107.91
Avg. profit /Kg live weight (PKR)	11.30	4.65	10.08

M = male F = female SR = straight run

***Conclusion*:** Our study found that high-density diets improve commercial broiler development and immunity. This diet boosts feed conversion ratios, body weight gains, and Newcastle disease antibody responses, indicating enhanced bird health and resistance.

Male broilers were more profitable than females or mixed-sex broilers. Males have higher growth and feed efficiency, increasing economic returns. These data imply that high-density feeding and sex-specific upbringing could optimize chicken production practices, improving profitability and bird health and performance. These approaches may also support agricultural sustainability and efficiency.

Authors' contributions: AA and SM executed the research and wrote the manuscript draft, SMQ assisted in the lab analysis, SM and BB manuscript reviewing, editing, and finalization.

Conflict of Interest: AAR executed the research and wrote the manuscript draft, AA assisted in the lab analysis, MFAC-manuscript reviewing, editing, and finalization.

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Ethical statement:

Availability of data and material: data will be available on the request by corresponding author

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Code Availability: Study was approved by University of Veterinary and Animal Sciences, Lahore, Pakistan board of research

***SDG's addressed*:** Zero Hunger, Responsible Consumption and Production.

REFERENCES

Abbasi, M.A., A.H. Mahdavi and A.H. Samie. 2012. Effect of feeding different protein and threonine levels on immunocompetence of broiler chicks. Journal of Applied Poultry Research 14:1-9

Al-Neemi, M.I.A., M.S.B. Al-Hlawee, I.N. Ezaddin, M.M. Zenabdeen, K.M. Noory, and S.S. Noradeen. 2016. Male and female broiler growth performance, carcass traits and economic indicators as influenced by feeding programs (regimes) of diets. International Journal of Applied Biology and Pharmaceutical Technology 7:0976-4550.

Beard, C.W. 1989. Serological procedures. In Laboratory manual for the isolation and Identification of avian pathogens published by American association of pathologists, 3 ED. pp. 192-200.

Bouvarel, I., B. Barrier-Guillot, P. Larroude, B. Boutten, C. Leterrier, F. Merlet, M. Vilarin, L. Roffidal, S. Tesseraud, J. Castaing, and M. Picard (2004). Sequential

feeding programs for broiler chickens: twenty four and forty eight hour cycles. Poultry Science 83:49-60.

Bregendahl, K., J.L. Sell and D.R. Zimmerman. 2002. Effect of low protein diets on growth performance and body composition of broiler chicks. Poultry Science 81:1156-1167.

Cengiz, O., A.G. Onol, O. Sevim, M. Oztürk, M. Sari and M. Daskiran. 2008. Influence of excessive lysine and/or methionine supplementation on growth performance and carcass traits in broiler chicks. Revue de Medecine Veterinaire 4:230-236.

Corzo, M.T., D. Kidd, J. Burnham, E.R. Miller, S.L. Branton and R. Gonzalez-Esquerra. 2005. Dietary amino acid density effects on growth and carcass of broilers differing in strain cross and sex. Journal of Applied Poultry Research 14:1-9.

Dozier, W.A., J.P. Thaxton, J.L. Purswell, H.A. Olanrewaju, S.L. Branton and W.B. Roush. 2006. stocking density effects on male broilers grown to 1.8 kilograms of body weight. Poultry Science 85:344-351.

Dozier, W.A. and E.T. Moran Jr. 2001. Response of early and late-developing broilers to nutritionally adequate and restrictive feeding regimens during the summer Journal of Applied Poultry Research 10:92-98.

Gheisari, H.R., K. Asasi, I. Mostafa and E. Mohsenifard. 2015. Effect of Different Levels of Dietary Crude Protein on Growth Performance, Body Composition of Broiler Chicken and Low Protein Diet in Broiler Chicken. International Journal of Poultry Science 14:285-292.

Gunes, N., U. Polat and M. Petek. 2002. Investigation of changes in biochemical parameters of hens raised in alternative housing systems. ULUDAĞ ÜNİVERSİTESİ - Veteriner Fakültesi Dergisi 21:39-42.

Ilori, B.M., S.O. Peters, C.O.N. Ikeobi, A.M. Bamgbose, C.E. Isidahomen and M.O. Ozoje. 2010. Comparative assessment of growth in pure and crossbred Turkeys in a humid tropical environment. International Journal of Poultry Science 9:368-375.

Kamran, Z., M. Sarwar, M. Nisa, M. Nadeem, S. Mahmood, M. Babar and S. Ahmed. 2008. Effect of low-protein diets having constant energy-to-protein ratio on performance and carcass characteristics of broile r chickens from one to thirty-five days of age. Poultry Science 87:468-474.

Mostafa, E. 2012. The Effect of Sex, Age and Live Weight 2-on Cholesterol and Lipid Levels in Broilers Fattened to Higher Live Weights. Journal of Applied Poultry Research 16:454-462.

Novel, D.J., J.W. Ng'ambi, D. Norris and C.A. Mbajiorgu. 2009. Effect of Different Feed Restriction Regimes During the Starter Stage on Productivity and Carcass Characteristics of Male and Female Ross 308 Broiler Chickens. International Journal of Poultry Science 8:35-39.

Olayode, R., Folorunso, A. Aanuoluwapo, Adesua, E. Gbenga and Onibi. 2014. Response of broiler chickens to diets of varying protein contents under ad libitum and skip-a-day feeding regimes. 9:13-118.

Pesti, G.M. 2009. Impact of dietary amino acid and crude protein levels in broiler feeds on biological performance. Journal of Applied Poultry Research 18:477-486.

Roy, S.C., M.S. Alam, M.A. Ali, S.D. Chowdhury and C. Goswami. 2010. Different levels of protein on the performance of synthetic broiler. Bangladesh Journal of Veterinary Medicine 8:117-122.

Sterling, K.G., G.M. Pesti and R.I. Bakalli. 2003. Performance of Broiler Chicks Fed Various Levels of Dietary Lysine and Crude Protein. Poultry Science 82:1939-1947.

Xie, D., Z.X. Wang, Y.L. Dong, J. Cao, J.F. Wang, J.L. Chen and Y.X. Chen. 2008. Effects of monochromatic light on immune response of broilers. Poultry Science 87:1535-1539.

Fayeye, T.R., K.L. Ayorinde, V. Ojo and D.M. Adesina. 2006. Frequency and influence of show major genes on body weight and body size parameters of Nigerian local chickens. Livestock. Research Rural Development 181-9.